

IV.—*On the Silurian System of Northern Maine, New Brunswick and Quebec.*

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Since the time of the publication, in 1842, of Dr. A. Gesner's Fourth "Report on the Geology of New Brunswick," the Upper Silurian age of the extensive tract comprising the northern counties of this Province has been generally accepted; the fossils collected from various localities along the St. John River, and again in the counties of Restigouche and Gloucester, indicating an horizon about that of the Niagara or Lower Helderberg formations. In his "Geology of Canada" for 1863, Sir W. E. Logan described at length the same formation, chiefly as found in the Province of Quebec, under the name of the "Gaspé Limestone" series, at the same time referring to its northern base as being found on Lake Temiscouata, where a high ridge abutting upon the lake, known as Mount Wissick or Mount Lennox, and abounding in fossils, was regarded as resting unconformably upon a series of beds at one time supposed to be Devonian, but then referred to the base of the Quebec group. In Northern Maine also the same formation had been early recognized by Jackson, and was subsequently more fully investigated (in 1860) by Packard and Hitchcock, the latter describing the Silurian rocks as found at Lake Sedgewick (Square Lake) and some other points, and which were richly fossiliferous, as being unconformably overlaid by a series of red shales and conglomerates, referred to the Devonian. In the meantime the limits of the formation in New Brunswick remained for the most part undefined, and were variously located by different observers. It was not until 1879 that, by simultaneous observations on either side of the St. John River, in Carleton county, made by Mr. G. F. Matthew and the author, something like satisfactory data upon these points were obtained; the unconformity of the Silurian system with the associated rocks, more particularly along the Beccaguimic valley, being then established upon the triple evidence of the composition of the conglomerates at the base of the former, the discordance of dip between the two, accompanied by progressive overlap, and finally of fossils, the lower rocks being found to hold a fauna apparently indicative of the age of the Trenton. In the same valley, at its mouth, a series of coarse conglomerates had been previously found by Mr. Chas. Robb to contain thin seams of shale abounding in remains of Psilophyta, and, upon the evidence of these, the beds containing them, together with a somewhat extensive tract of other coarse sediments occurring about the headwaters of the Beccaguimic, were referred (by Mr. R. W. Ellis) to the Devonian, and regarded as the equivalents of the Gaspé sandstones.

A contact of the Silurian with at least two other systems was thus indicated in the Beccaguimic valley. But as it was difficult, from the limited exposures of a single narrow stream, the strata of which are, for the most part, excessively disturbed, to remove all obscurity as to their true relations, the author was led, during the last summer, to visit

some of the other localities which have been referred to above, more particularly those of Square Lake and Temiscouata, with the hope that some additional light might be thrown upon these points. The results of the comparisons thus made seem to him to be of sufficient interest to justify their presentation here.

In order to understand these comparisons, some further reference is necessary to the Beccaguimic region. Briefly stated, the conditions here seen are about as follows. In the bed of the North Branch stream, just above Shaw's Mills, are a few exposures of dark grey siliceous slates, having a nearly vertical dip, which are here and there capped by brownish red conglomerates, in a nearly horizontal position, and through which ridges of the slate project irregularly. From observations elsewhere made in the vicinity it seems certain that the bulk of these conglomerates are of Lower Carboniferous age, though some, which are harder and of somewhat different aspect, appear to be older, and may be Silurian. A little higher up siliceous slates again appear, but these now contain calcareous bands, from which, in 1879, Mr. Matthew succeeded in obtaining a number of small shells, chiefly of a species of *Leptaena* (allied to *L. decipiens* of Billings), as well as others apparently of the genera *Lingulella*, *Strophomena* and *Discina*, to which later collections, made by myself, Mr. W. McInnes and Mr. W. T. Reed, have added several, though fragmentary, specimens of the trilobite genus *Harpes*. There can be but little question that these beds are of Cambro-Silurian age, either Trenton or lower, and they tend to confirm the view so long entertained that this is the real age of a part at least of the great bands of slates and quartzites which constitute so marked a feature in the geology of this part of New Brunswick.

Passing now to the hills which, at a distance of a few rods only to the north, overlook the valley at this point, we meet with strata of a widely different character. Among these is a band of grey conglomerates and grits, in which are contained numerous fragments of black siliceous slate and quartzite, apparently identical with that of the beds in the valley below, cemented by a calcareous paste, in which, as observed by Mr. Matthew, are contained numerous encrinural fragments. These conglomerates, which at a short distance to the north are followed by heavy beds of limestone, are regarded as the base of the Silurian system, and, with the associated limestones, containing numerous fossils, have been traced for considerable distances through the adjacent country. A ridge of these conglomerates crosses the North Branch valley three miles above Shaw's Mills (their high inclination being again strongly contrasted with that of the red Lower Carboniferous conglomerates near by), but between these points are other beds which give further interest to the exposures of this vicinity. These consist of a series of sandstones and slates, of which the former are often grey, purple or chocolate-brown in colour and in aspect not at all unlike some portions of the Lower Carboniferous formation, while the slates are dark-grey and black. Both are fossiliferous, but in the sandstones the fossils are few, consisting of scattered relics of Crinoids, Orthocerata, and Brachiopods, mostly fragmentary, while the shales on the other hand, at least in certain layers, abound in the remains of Graptolites. These were at first believed by Mr. Matthew to contain diprionidial forms, but, in larger collections subsequently made, none of the latter could be detected, while a further study of the adjacent district confirmed the idea that both the slates and sandstones were of the same age as the grey conglomerates, and all Silurian.

It only remains to state, with further reference to this region, that here and there

through these Silurian sandstones may be found the remains of branching plants, while at one point, in close proximity to the siliceous beds first described, is a small exposure of quartzose rock containing an abundance of what are evidently Psilophyta, apparently undistinguishable from those found by Mr. Robb near the mouth of the river. As the conglomerates in which the latter occur are not unlike those described above as forming part of the Silurian succession, and as the plant-bearing beds above Shaw's Mills are almost certainly of this age, it is at least possible that all these rocks are really Silurian rather than Devonian, as some of them have been supposed to be.

I now pass to the region of the Fish River lakes in Northern Maine.

The description of the rocks found in this vicinity, as given in Hitchcock's "Report on the Geology of Maine" (1861, pp. 420-424) is from the pen of Prof. A. S. Packard, jun., who, however, does not himself express any opinion as to their age. Among these rocks the most interesting is a band of highly fossiliferous limestone, outcropping on the western shore of Square or Sedgewick Lake, and which has to some extent been locally employed as a source of lime. From collections made at the locality by Packard and Hitchcock, the late Mr. Billings succeeded in recognizing about forty distinct species, of which fourteen were new, while my own visit to the locality, though short, enabled me to obtain a somewhat greater number, including, as determined by Mr. Ami, two additional species not hitherto described. These fossils have been regarded, both by Mr. Billings and Mr. Ami, as being of Lower Helderberg age, and the enclosing beds, in this as in other respects, may be regarded as the counterpart of the limestone beds of the Beccaguimic region, in New Brunswick. Associated with these beds on Square and Eagle Lakes, and apparently enclosing them, there are, as described by Packard, ledges of red shale and conglomerate, with beds of grit, the conglomerates containing fragments of dark slate and jasper, and dipping 45° to the northward, in which direction they are followed, first, by buff-weathering fossiliferous sandstones and then by dark clay-slates, which, with other slates and sandstones, occupy the remainder of the country northward and eastward to the St. John River valley. A like succession was observed on the thoroughfare from Portage Lake, a few miles west of Eagle Lake, and at Ashland. All the rocks of the above section have been regarded by Prof. Hitchcock as Devonian, and are so represented in his map of Northern Maine, as they are in that accompanying the last edition of Sir Wm. Dawson's "Acadian Geology." If however the above relations are as supposed, it would seem altogether probable that the great bulk of strata here met with is, as on the Beccaguimic, of Silurian rather than Devonian age. I may add, from personal examination, that in almost every particular the beds of the Fish River lakes bear the closest resemblance to the beds which accompany and enclose the limestones of the Beccaguimic valley.

It is true that no graptolite-bearing beds were here observed, but beds of very similar character occur, while even on the Beccaguimic these beds are but thin. Moreover, in both instances the sandstones exhibit the same peculiar Lower Carboniferous aspect. Both contain similar remains of crinoids and shells, mingled with stems of plants, while the conglomerates in both are also alike in containing numerous fragments of black slate associated with others of bright green and red jasper. If to this we add the fact that, beneath the conglomerates, etc., above described, we have, on the shores of Portage or Nadeau Lake, connected with the other or westerly branch of Fish River, a well defined

belt of dark green siliceous slate,¹ described by Packard under the name of hornstone, and containing massive beds of bright red cherty slate, with a nearly vertical dip, we appear again to have a repetition of the relations found on the Beccaguimic, these cherty slates being, as we believe, the equivalents of the flinty slates of Shaw's Mills and, like the latter, of Cambro-Silurian age. The following tabular view will serve to make this parallelism more evident:—

1.—BECCAGUIMIC SECTION.

A. *Cambro-Silurian*.

Black calcareo-siliceous slates, with brachiopods and trilobites.

B. *Silurian*.

1. Grey calcareous conglomerates and grits, holding fragments of black siliceous slates and quartzite, jasper, etc., mingled with remains of crinoids.
2. Grey, reddish and brown sandstones and slates, associated with beds of fossiliferous limestone.
3. Grey conglomerates.
4. Grey, calcareous and buff-weathering sandstones, with stems of crinoids and shells.
5. Grey and dark grey slates, with graptolites and remains of plants.
6. Grey, bluish-weathering and calcareous slates. ■

2.—FISH RIVER SECTION.

A. *Cambro-Silurian* ?

Dark cherty slates, with bands of jasper.

B. *Silurian*.

1. Grey calcareous conglomerates ? not observed.
2. Grey, reddish and brown sandstones and shales, associated with beds and containing enclosed masses of fossiliferous limestone.
3. Grey, calcareous conglomerate, with pebbles of dark flinty slate, jasper, etc.
4. Grey, calcareous and buff-weathering sandstones, with crinoids and shells.
5. Grey and dark grey slates, with remains of plants.
6. Grey, bluish-weathering, calcareous slates.

I pass now, thirdly, to the Temiscouata region. Between the latter and the region of the Beccaguimic in Carleton county, the St. John River affords an admirable section of the Silurian system, without, however, exposing any beds which can with certainty be regarded as representing its base. For nearly the whole distance of one hundred and fifty miles, including the Madawaska River and the southern half of Lake Temiscouata, the only rocks seen are slates with occasional alternating beds of fine sandstone, mostly of grey or dark grey colours, but occasionally red or green, the beds of this latter colour being usually associated with beds of impure hematite. They are very generally calcareous, and at times highly so, but no actual beds of limestone occur. They are also at many points fossiliferous, the fossils including species similar to those of the Beccaguimic, and, like the latter, appearing to indicate an Upper Helderberg horizon. Finally, they have been subject to extensive disturbance, the plications being general and of the most complicated character.

The first beds of a markedly different aspect from the above are met with upon the

¹ These beds bear some resemblance to the beds of Pointe aux Trembles or Temiscouata Lake, to be presently described, and their true position, in both instances, is somewhat uncertain.

Tuladie River, not far from its mouth, and again on the shore of Lake Temiscouata, at a point nearly opposite the Tuladie, where they are alluded to in the elaborate section of this vicinity, given by Sir W. E. Logan, as "the beds of Pointe aux Trembles." These rocks are massive sandstones, of somewhat dioritic aspect and with bands of purple jasper, which pass into and include beds of conglomerate, the pebbles and matrix of which are both composed of dark grey or purplish-grey porphyritic petrosilex, mingled at times with fragments of black slate. Above these beds on the shores of the lake, but stratigraphically beneath them, the rocks next seen are shales and slates, alternating with sandstones, in which we have lately obtained fragments of ribbed shells. Similar beds are well exposed at the Tuladie Falls, and like the Silurian slates on the shores of the lake, have a pretty uniform south-easterly dip of 70° . The next beds north are those of Black and Burnt Points (*vide* Logan's section), and are again composed of conglomerates and sandstones, but with the former now greatly predominating and having quite a different aspect from those of Pointe aux Trembles, being not only very coarse, but of different composition, the pebbles consisting largely of metamorphic rocks, such as quartzite, white sandstone, mica schist, etc., mingled with many of limestone. These beds have also a south-eastward dip of $50-60^\circ$, and a measured thickness of nearly 1000 feet. They are further described by Logan as probably belonging to the Quebec group, and as being unconformably covered by the limestones of Mount Wissick next to be noticed.

An interval of about 1500 yards separates Burnt Point from the eminence last named, on whose almost precipitous north-western face (attaining an elevation of 550 feet) a most remarkable and interesting section of the rocks composing it may be seen. The order of succession and the thickness of the beds, as condensed from Logan's Report, is as follows:—

	FEET.
Whitish massive sandstone.....	45
Grey coarse calcareous conglomerate, with pebbles of limestone and quartz.....	20
Measures concealed.....	90
Green sandstone, with conglomerate bands, as above.....	20
Red and green shales, with included fossiliferous limestone.....	125
Grey nodular limestone, abounding in fossils.....	50
Grey hard sandstone, without observed fossils.....	10
Grey fossiliferous and columnar limestone.....	20
Grey arenaceous limestones and sandstones, with fossils, forming the bulk of Mount Wissick, and from the height of the latter estimated as having a thickness of.....	500

The dip of the above strata is given as S. 50° , E. $< 13^\circ$, and it is from this low dip chiefly, as compared with the high inclination of the beds north and south of the mountain, that they are regarded as unconformable to the latter, and as being a part of the Gaspé limestone series. The strata north of the mountain are grey calcareous sandstones and arenaceous limestones, with dark-banded green slates, highly inclined and greatly contorted, which are regarded as belonging to the base of the Quebec group, although originally classed and mapped as Devonian.

Reviewing the above, it would appear that, in the view of Logan, the line of separation between the Silurian system (Gaspé limestones) and that of the Quebec group is to be found at or near Pointe aux Trembles, all the strata north of the latter, except those of

Mount Wissick, and including the heavy conglomerates of Black and Burnt Points and the rocks of the Tuladie and Cabano, being referable to that group, while those to the south, together with those of Mount Wissick, are to be referred to the Gaspé Limestone series or Silurian. It is, however, to be observed that Sir William himself seems to have been in doubt upon this point, for while on one page (423) he describes the conglomerates of Black Point as belonging to the Quebec group, he subsequently refers to them (page 427) as being newer than the latter. On the other hand, the very striking resemblances which portions of these beds bear to those of the Beccaguimic and the Fish River lakes can hardly fail to attract attention. Thus the conglomerates of Black Point, though vastly thicker and coarser than anything seen in New Brunswick or Maine, apparently occupy the same position as those described on the southern side of the great Silurian plateau. They are, indeed, compared by Logan with a certain band of conglomerates met with near the mouth of the Siegas, fifty or more miles to the south, in the Silurian tract, a comparison which further indicates the uncertainty of opinion in which they were held by him. Again, both the green and red shales and fossiliferous limestones of Mount Wissick, though as regards the latter of much greater thickness, occupy the same relative position and bear much resemblance, both in aspect and in their fossils, to those of Fish River and the Beccaguimic. These fossils include large corals (*Favosites*) Brachiopods (*Strophomena*, *Leptana*, *Pentamerus*, etc.), besides several species of Trilobites, and are probably of Lower Helderberg age, but until they have been accurately determined this comparison is uncertain. The most remarkable difference in the Mount Wissick beds, as compared either with those of the Beccaguimic River or the Fish River lakes, is that afforded by the massive white sandstones or quartzites which form the apparent base of the eminence referred to. No such rocks are to be met with anywhere over the extensive Silurian tracts of Northern Maine or New Brunswick. They do, however, bear much resemblance to the beds of like composition seen at frequent intervals along the Portage road between Temiscouata and Rivière du Loup, and again along the line of the Intercolonial Railway between the Metapedia River and Rimouski. The greater part of these, however, belong to the Quebec group, while those of Mount Wissick are interstratified with the fossiliferous limestones of the mountain, and are unquestionably part of the same formation. I am also informed by Mr. R. W. Ells that similar sandstones were found by Mr. Richardson to contain remains of *Pentamerus oblongus*. As the beds underlying them at Mount Wissick are almost entirely of the Quebec group, these quartzites would appear to form here the lowest member of the Silurian system, which would also appear to include all the beds of Lake Temiscouata south of this point—among them the conglomerates of Black and Burnt Points and the rocks of Pointe aux Trembles previously referred to the Cambro-Silurian.

The Temiscouata section, as compared with those of northern Maine and New Brunswick, previously quoted, would thus stand as given on the succeeding page.

I may add that, since reading the above paper, further examinations of the region about Lake Temiscouata, as well as of portions of Aroostook county, Maine, have been made, and numerous fossils obtained from Pointe aux Trembles, Tuladie Lake and elsewhere. These are now in the hands of Mr. Whiteaves, and the results of their examination will appear in the reports of the Geological Survey.

ASCENDING SECTION OF SILURIAN ROCKS.

LAKE TEMISCOUATA.

A. *Cambro-Silurian.* (Quebec Group.)

Greenish, reddish and black slates, banded with thin layers of dolomitic limestone.

B. *Silurian.*

	FEET.
Whitish sandstones.....	200
Calcareous conglomerates and sandstones, with limestone pebbles.....	130
Red and green shales, including fossiliferous limestones.....	125
Grey nodular limestones, abounding with fossils, and including bands of hard sandstone.....	580
Measures concealed.....	1276
Conglomerates (of Black and Burnt Points), with pebbles of Cambro-Silurian rocks, including limestones.....	1000
Measures concealed.	
Dark shales and sandstones, with fossils.	
Green and purplish sandstones and conglomerates, forming Pointe aux Trembles.	
Grey-bluish weathering slates and sandstones, continuous with those of Maine and New Brunswick.	